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MECHANICAL-PROPERTY DATA CT 91-T7E69 ALUMINUM, POWDER METALLURG--ETC (U)

SEP 81

F33615-80-C-5168

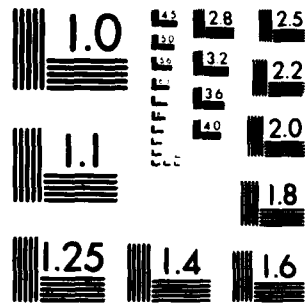
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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MECHANICAL-PROPERTY DATA
CT 91-T7E69 ALUMINUM

POWDER METALLURGY PRODUCT

Issued by

Air Force Wright Aeronautical Laboratory
Materials Laboratory
Wright-Patterson Air Force Base, Ohio

September, 1981

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Columbus, Ohio 43201

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CT 91-T7E69 Aluminum

Material Description

CT 91-T7E69 aluminum alloy is a powder metallurgy product of Alcoa. The material was received as two $1\frac{1}{2}$ -inch thick x $4\frac{1}{2}$ -inch wide x 4-foot lengths.

The chemical composition of this lot is as follows:

<u>Chemical Composition</u>	<u>Percent Weight</u>
Silicon	0.15
Iron	0.20
Copper	1.20 - 2.00
Magnesium	2.20 - 3.00
Zinc	6.00 - 7.00
Cobalt	0.20 - 0.60
Other	0.15
Aluminum	Balance

Processing and Heat Treating

The CT 91 aluminum was received in the T7E69 condition. This temper was designed to have good static strength and fatigue resistance.

Results of these tests show higher tensile, shear, and fatigue data as compared to the T7E70 temper while giving lower fracture toughness values.

Condition For	
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CT 91 Aluminum^(a)

Condition: T7E69

Thickness: 1½ inch

Properties	Temperature, F (K)					
	RT	(RT)	250	(394)	350	(450)
<u>Tension</u>						
TUS, L, ksi (MPa)	89.6	(617.3)	74.5	(513.7)	59.2	(408.2)
TUS, T, ksi (MPa)	83.6	(576.4)	69.8	(481.3)	54.9	(379.5)
TYS, L, ksi (MPa)	83.0	(572.3)	72.9	(502.6)	57.5	(396.5)
TYS, T, ksi (MPa)	74.9	(516.4)	66.1	(455.8)	52.2	(359.9)
e, L, % in 2 in. (50.8 mm)	11.0		18.7		22.6	
e, T, % in 2 in. (50.8 mm)	11.7		17.2		21.5	
E, L, 10 ³ ksi (GPa)	10.8	(74.5)	9.77	(67.4)	9.25	(63.8)
E, T, 10 ³ ksi (GPa)	10.8	(74.5)	9.49	(65.4)	9.00	(62.1)
RA, L, Reduction in area, %	28.8		50.3		62.9	
RA, T, Reduction in area, %	29.0		41.3		52.1	
<u>Compression</u>						
CYS, L, ksi (MPa)	83.1	(573.0)	75.3	(519.2)	57.0	(393.0)
CYS, T, ksi (MPa)	80.8	(557.1)	72.0	(496.4)	57.0	(393.0)
E _c , L, 10 ³ ksi (GPa)	10.6	(73.1)	9.3	(64.1)	8.7	(60.0)
E _c , T, 10 ³ ksi (GPa)	10.0	(69.0)	9.8	(67.6)	8.5	(58.6)
<u>Shear</u>						
SUS, L, ksi (MPa)	52.8	(363.9)	44.6	(307.5)	35.3	(243.4)
SUS, T, ksi (MPa)	49.8	(343.2)	43.7	(301.3)	33.1	(228.2)
<u>Bearing</u>						
e/D = 1.5						
BUS, L, ksi (MPa)	135.1	(931.5)	111.0	(765.3)	86.00	(593.0)
BUS, T, ksi (MPa)	130.7	(901.2)	111.6	(769.5)	83.68	(577.0)
BYS, L, ksi (MPa)	107.6	(741.9)	95.9	(661.2)	78.09	(538.4)
BYS, T, ksi (MPa)	108.0	(744.7)	97.4	(671.6)	76.79	(529.5)
e/D = 2.0						
BUS, L, ksi (MPa)	171.7	(1183.9)	145.6	(1003.9)	108.3	(746.7)
BUS, T, ksi (MPa)	170.6	(1176.3)	146.6	(1010.8)	108.9	(750.9)
BYS, L, ksi (MPa)	126.0	(868.8)	111.8	(770.9)	89.1	(614.3)
BYS, T, ksi (MPa)	127.7	(880.5)	112.1	(772.9)	89.9	(619.9)

(Continued)

Properties	Temperature, F (K)					
	RT	(RT)	250	(394)	350	(450)
Fracture Toughness						
K_{IC} , L-T, ksi $\sqrt{\text{in.}}$ (MPa $\cdot\text{m}^{1/2}$)	24.2	(26.6)	(b)	NA ^(c)		NA
K_{IC} , T-L, ksi $\sqrt{\text{in.}}$ (MPa $\cdot\text{m}^{1/2}$)	35.1	(38.6)		NA		NA
Axial Fatigue (Transverse)^(e)						
Unnotched, R = 0.1						
10 ³ cycles, ksi (MPa)	79.0	(544.7)		NA	54.0	(372.3)
10 ⁵ cycles, ksi (MPa)	64.9	(447.5)		NA	49.7	(342.7)
10 ⁷ cycles, ksi (MPa)	59.0	(406.8)		NA	28.9	(199.3)
Notched, $K_t = 3.0$, R = 0.1						
10 ³ cycles, ksi (MPa)	61.0	(420.6)		NA	50.0	(344.8)
10 ⁵ cycles, ksi (MPa)	23.5	(162.0)		NA	16.0	(110.3)
10 ⁷ cycles, ksi (MPa)	20.0	(137.9)		NA	10.0	(69.0)
Stress Corrosion^(d)						
$K_{ISCC} = 3 \text{ ksi}\sqrt{\text{in.}}$ (3.3 MPa $\cdot\text{m}^{1/2}$)						
Density						
$\omega = 0.102 \text{ lb/in.}^3$ (2.823 g/cc)						

(a) Values are average of triplicate tests conducted at Battelle under the subject contract unless otherwise indicated. Fatigue values are from curves generated using the results of a greater number of tests.

(b) K_{IC} is valid as per ASTM E399.

(c) NA, not applicable.

(d) This value is an approximate determination of K_{ISCC} at 10^{-8} in./sec. (25.4×10^{-8} mm/sec.). This value appears low due to scatter. The increasing K tests lasted an average of 3 days and were conducted at 75 F (297 K) in 3 1/2% NaCl. Compact-tension-type specimens were used.

(e) The unnotched fatigue tests were conducted using a test section diameter of 0.18 inch (4.57 mm). ASTM E466 suggests a test section diameter between 0.200 inch (5.08 mm) and 1.000 inch (25.4 mm), however it is felt these are valid test results.

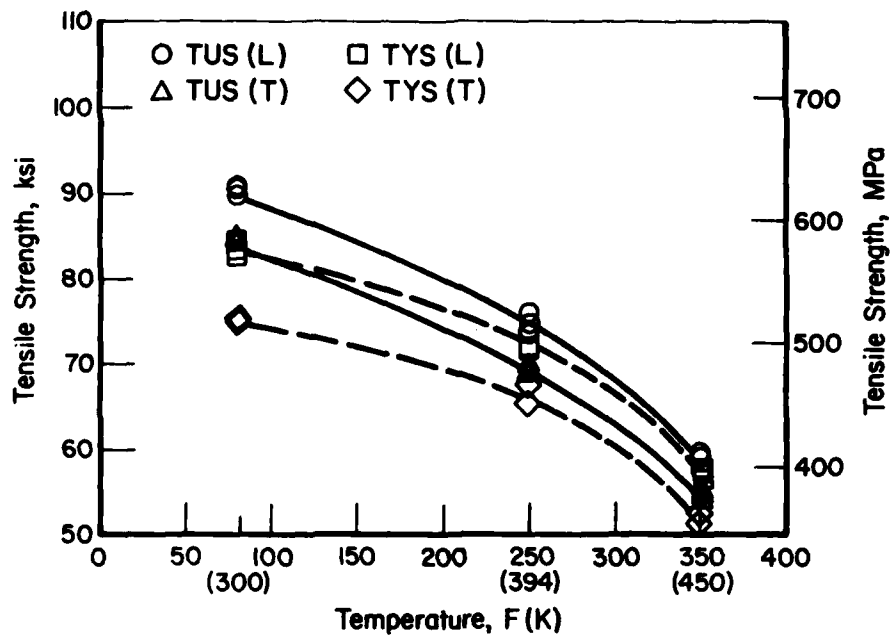


Figure 1. Effect of temperature on the tensile strength of CT 91-T7E69 aluminum.

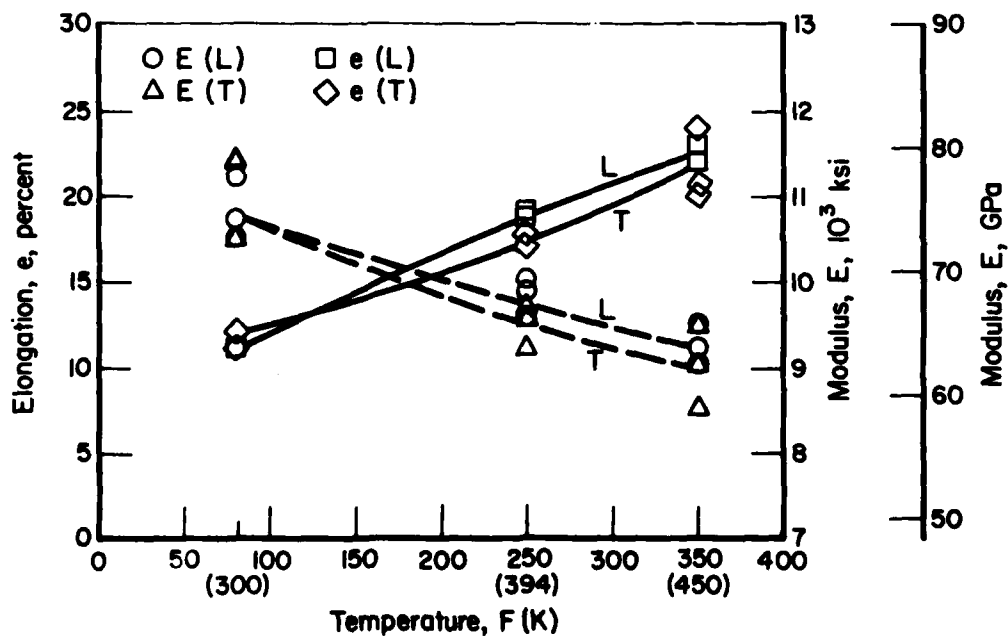


Figure 2. Effect of temperature on tensile properties of CT 91-T7E69 aluminum.

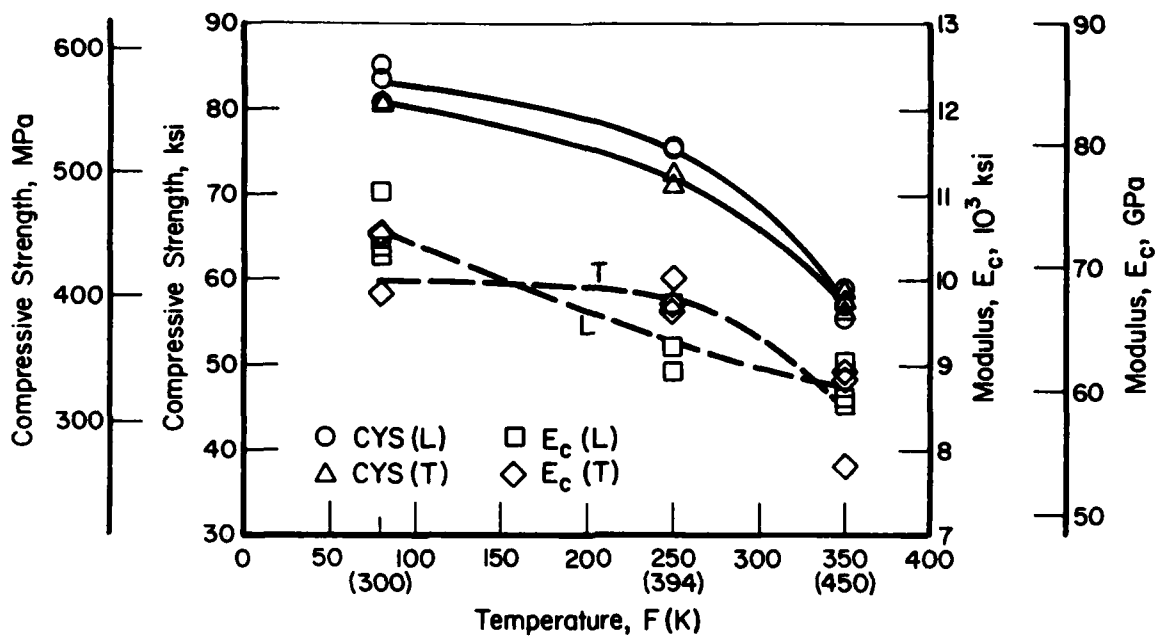


Figure 3. Effect of temperature on the compressive properties of CT 91-T7E69 aluminum.

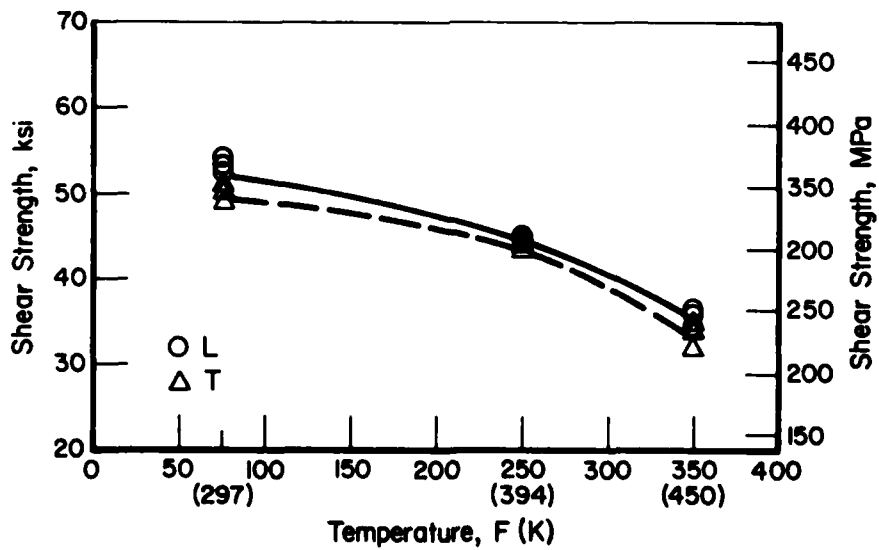


Figure 4. Effect of temperature on pin shear properties of CT 91-T7E69 aluminum.

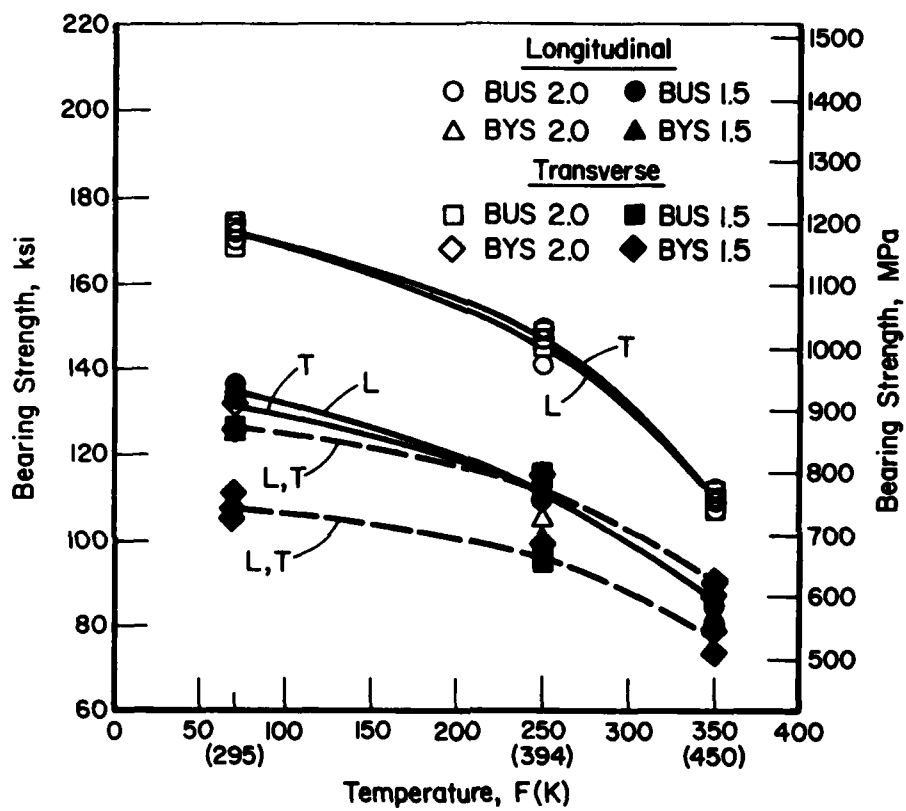


Figure 5. Effect of temperature on the bearing properties of CT 91-T7E69 aluminum.

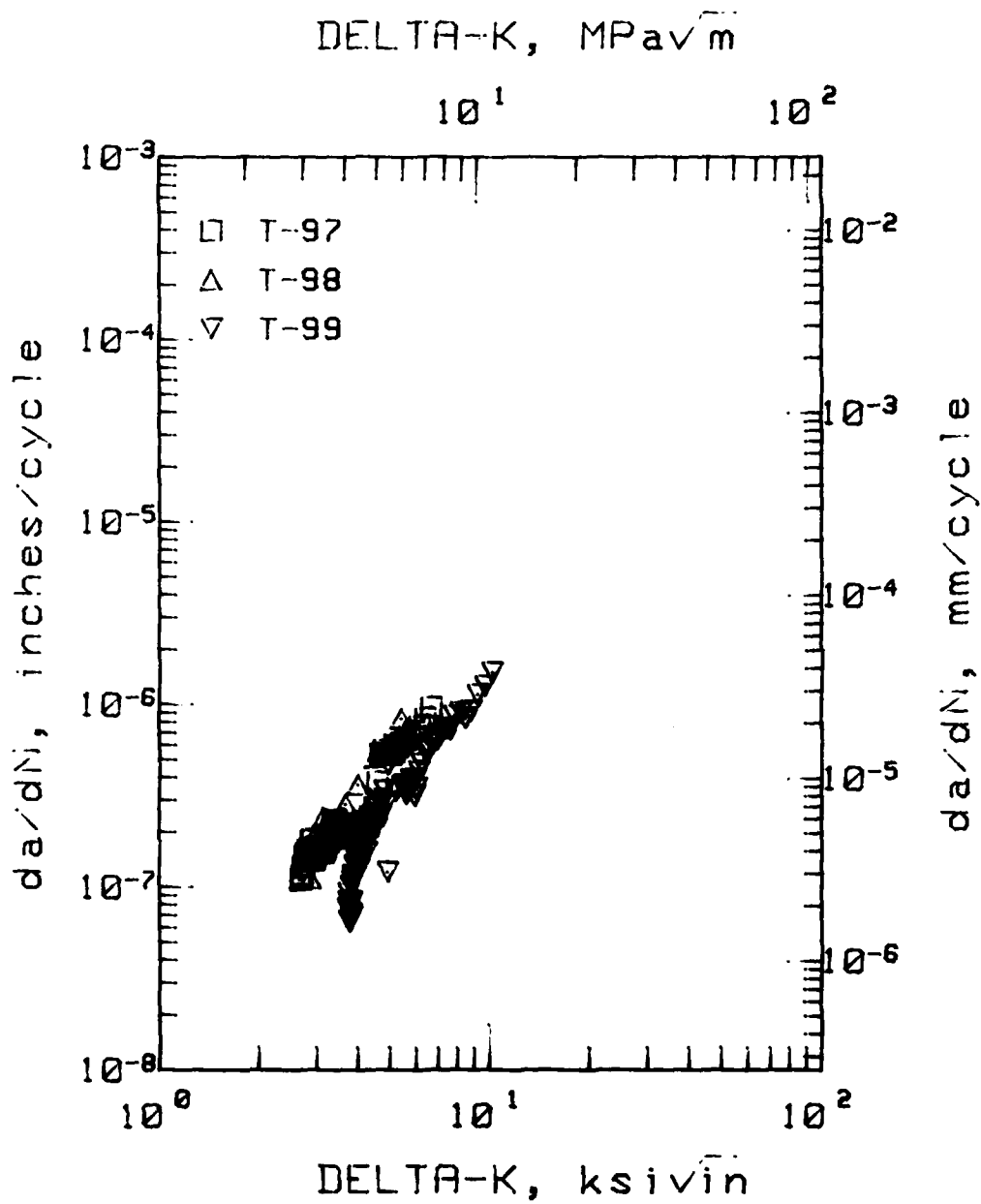


Figure 6. da/dN versus ΔK for CT 91-T7E69 aluminum.

Lab Air

$R = 0.1$

Frequency = 20 Hz

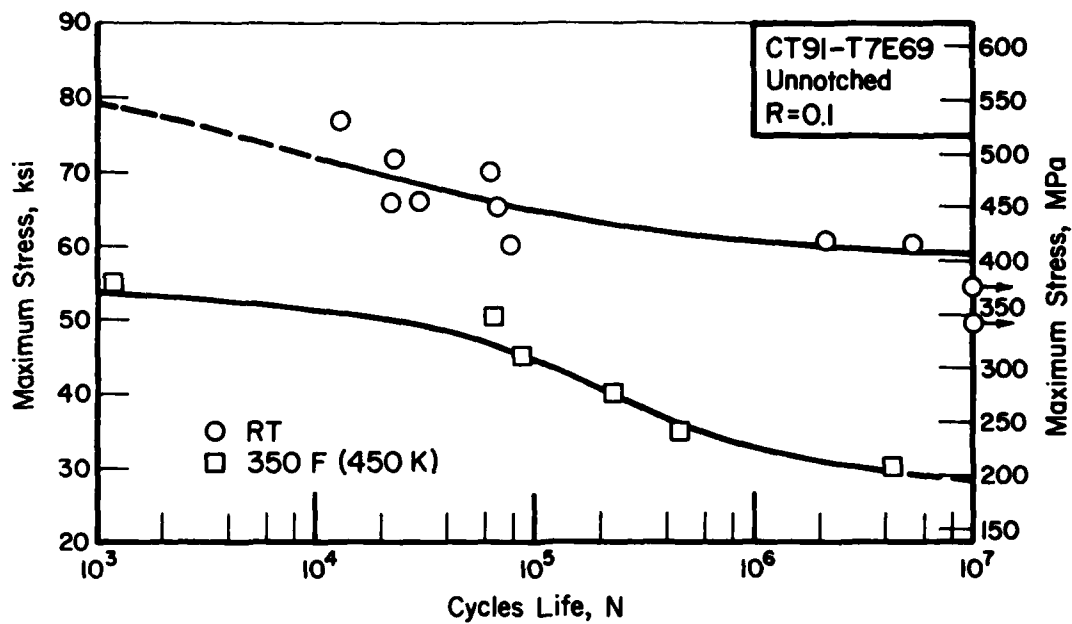


Figure 7. Axial load fatigue behavior of unnotched CT 91-T7E69 aluminum.

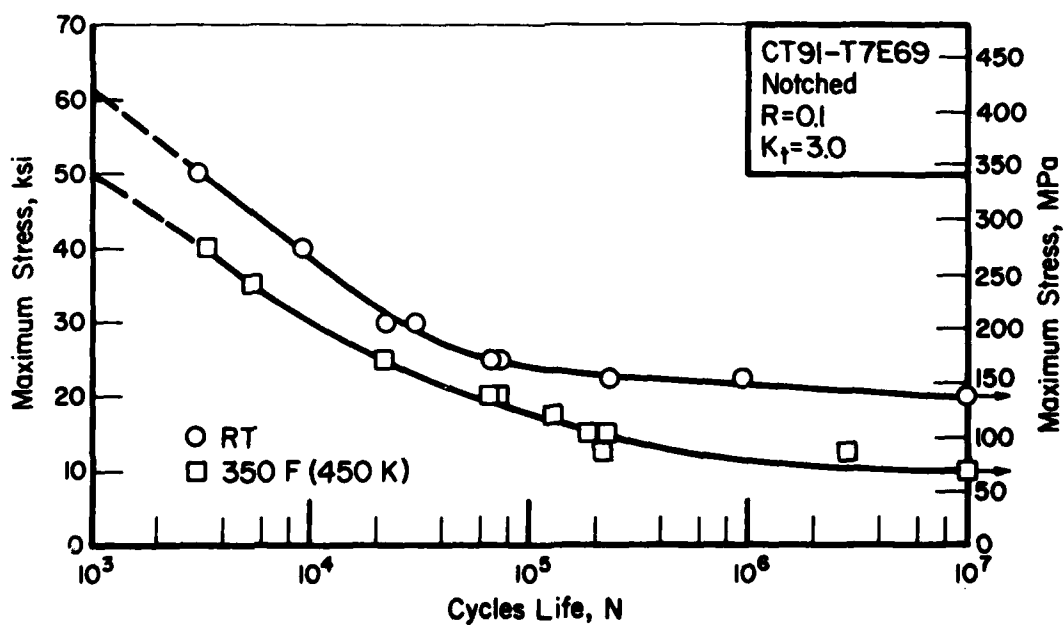


Figure 8. Axial load fatigue behavior of notched ($K_t = 3.0$) CT 91-T7E69 aluminum.

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